

**REMARKS**

Upon entry of the Amendment, Claims 1-38 will be pending in the application.

Reconsideration and review of the claims on the merits are respectfully requested.

***Formal Matters***

Applicants note with appreciation that the Examiner has acknowledged Applicants' claim for foreign priority and receipt of the priority document.

Applicants also note with appreciation that the Examiner has returned initialed copies of the PTO Forms SB/08 filed with Applicants' Information Disclosure Statements submitted October 24, 2000 and June 15, 2001.

***Response to Objections to the Specification***

The Examiner objects to the disclosure because of the following informalities: at page 8/18, line 15, there appears to be a typographical error where "9400)" should be "(400)". Page 14/15 is assertedly missing from the specification. At page 17, line 20 (in claim 26) it appears that a comma is missing between the words "one" and "two".

Applicants respond as follows.

Applicants have amended the specification to correct the informalities on pages 8 and 17. The Examiner also indicates that page 14, and possibly page 15, is missing from her records. Applicants attach copies of pages 14-15 for the Examiner's records, and also provide the Examiner a copy of the filing receipt indicating that 18 total pages were originally filed.

***Response to Objection to Drawings***

The Examiner objects to the drawings under 37 CFR 1.83(a). The Examiner states that the drawings must show every feature of the invention specified in the claims, and states that the element of Claim 26 "wherein 2, 4, 6 or more of said systems are radially coupled to the riser of a fluid catalytic cracking equipment, at one two or more riser levels, at an elevation angle between 30 and 70°" must be shown or the features canceled from the claims.

Applicants respond as follows.

Applicants submit herewith two drawings (Figures 5 and 6) to illustrate the embodiment in Claim 26 having four of the feed-dispersion systems of the invention radially coupled to the riser of an FCC unit, at two riser levels, at an elevation angle between 30 and 70°. The drawings add no new matter.

Approval of Figs. 5 and 6 is respectfully requested, along with reconsideration and withdrawal of the Examiner's objection.

***Response to Claim Rejections - 35 U.S.C. § 112***

Claims 1-27 are rejected under 35 U.S.C. 112, second paragraph, as allegedly being indefinite.

The Examiner states that there is insufficient antecedent basis for the limitation in Claim 1 reciting "the discharge zones" in lines 19-20.

The Examiner also states that Claim 1 is unclear as to the structural definition of the nozzles "geometrically placed so as to transfer, by contact, the energy of the atomization fluid to

the flow of liquid feed". The Examiner states that this geometry is not defined in the specification, and it is unclear to the Examiner as to what placements are encompassed by this limitation. For examination purposes, the Examiner states that this limitation has not been given weight in the claims since no scope can be determined.

The Examiner also states that Claim 16 recites that the angle  $\alpha$  is a function of the number of nozzles. The Examiner is unclear as such a function or relationship has assertedly not been defined in the specification. Since the Examiner believes that a relationship has not been defined, the scope of this claim allegedly cannot be determined, and the Examiner has not examined Claim 16 on its merits.

The Examiner also states that Claim 27 provides for the use of the apparatus of Claim 1, but since the claim assertedly does not set forth any steps involved in the method/process, the Examiner is unclear what method/process Applicants are intending to encompass.

Applicants respond as follows.

Regarding the term "discharge zones" in Claim 1, support can be found in the specification, for example, at page 11 and Figure 2A, indicating that the combination of the flows of feed and atomization fluid provides the prompt atomization of the liquid stream and generates a spray, or discharge into a discharge zone, where a universe of droplets is discharged into a mixing chamber (element 101 of Figure 2A) designed so as to avoid the coalescence of the feed droplets freshly dispersed by the atomization fluid. Chamber (101) is an open space, which is a discharge zone, where the liquid jets from the side feed nozzles (120) and already atomized by the high speed jets of the atomization fluid are admixed and form a homogenous spray having

a fan-like shape (see page 11, lines 16-23). Thus, Applicants submit that the term “discharge zones” is adequately supported by the specification and drawings.

Regarding the recitation in Claim 1 of nozzles "geometrically placed so as to transfer, by contact, the energy of the atomization fluid to the flow of liquid feed", Applicants point to support in the specification, for example, in page 11, line 16 to page 12, line 16, and, for example, in Fig. 2A, illustrating the same. Thus, Applicants submit that the term “geometrically placed so as to transfer, by contact, the energy of the atomization fluid to the flow of liquid feed” is adequately supported and defined by the specification and drawings.

Regarding the angle  $\alpha$  in Claim 16, support can be found in the specification, for example, at page 12, describing that the angle  $\alpha$  is the opening angle of the mixing chamber, as measured in the direction of the sequence of atomization fluid nozzles (page 12, lines 3-4). According to the preferred mode, the angle  $\alpha$  may vary between 5 and 90°, and is preferably in the range of from 10° to 60°,  $\alpha$  being a function of the number of nozzles (110) (see page 12, lines 7-11).

Regarding Claim 27, Applicants have rewritten and amended Claim 27 to more clearly recite the steps of the method. Entry of the amendment is respectfully requested.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections under 35 U.S.C. § 112, second paragraph.

Applicants have also amended Claims 1 and 25 to improve their grammar. In addition, Claims 3, 9, 14, 16, 18 and 22 have been amended to place them in proper form for U.S. practice, and new Claims 28-38 have been added, reciting subject matter previously included in Claims 9,

14, 16, 18, 22 and 3. No new matter has been added, and entry of the amendments is respectfully requested.

***Response to Claim Rejections - 35 U.S.C. § 101***

Claim 27 is rejected under 35 U.S.C. 101 because the claimed recitation of a use, without setting forth any steps involved in the process, allegedly results in an improper definition of a process, i.e., results in a claim which is not a proper process claim under 35 U.S.C. 101.

As described above, Applicants have rewritten Claim 27. Applicants submit that Claim 27 now more clearly satisfies the requirements of 35 U.S.C. § 101.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 101.

***Response to Claim Rejections - 35 U.S.C. § 102***

A. Claims 1-6 and 10 are rejected under 35 U.S.C. 102(b) as allegedly being anticipated by Chen et al. (U.S. Pat. No. 5,794,857).

B. Claims 1-7, 9, 11-15, 17-19 and 23-25 are rejected under 35 U.S.C. 102(e) as allegedly being anticipated by Chen (U.S. Pat. No. 6,387,247).

Applicants respond as follows.

Applicants have amended Claim 1 to recite “an atomizing unit comprising nozzles arranged in rows, with a central row formed by the sequence of nozzles connected on one end to the inner conduit of atomization fluid and connected to a mixing chamber on the other end, and

by at least one side row formed by the sequence of side nozzles connected on one end to the outer feed conduit and connected to the mixing chamber on the other end".

Applicants focus their remarks on independent Claim 1, since overcoming the rejections of the independent claim should overcome the rejections of the dependent claims as well.

Applicants traverse at least on the basis that neither Chen '857 nor Chen '247 anticipate each and every element of Applicants' claimed invention. For example, neither reference discloses a feed-dispersion system in which "the central nozzle(s) and side nozzle(s) of the said atomizing unit are geometrically placed so as to transfer, by contact, the energy of the atomization fluid to the flow of liquid feed".

Chen '857 and Chen '247 both disclose a feed nozzle or feed injection system in which the row of nozzles analogous to Applicants' central nozzles are placed so as to transfer the energy of the atomization fluid through the central nozzles into an area where the flow of liquid feed is mixed with the atomization fluid. However, neither Chen '857 or Chen '247 disclose the use of side nozzles geometrically placed so as to transfer, by contact, the energy of the atomization fluid to the flow of liquid feed. That is, whereas the side nozzles in Chen '857 and Chen '247 are used as an outlet passage from the mixing zone for the fine two-phase mixture of small dispersed bubbles in heavy petroleum hydrocarbon liquid (see Chen '247 Abstract), the side nozzles in the present invention act as a passage for only the liquid feed to be transferred into a mixing chamber where the liquid feed is then mixed with the atomization fluid.

Neither Chen '857 nor Chen '247 disclose the use of side nozzles geometrically placed so as to transfer, by contact, the energy of the atomization fluid to the flow of liquid feed, and

where at least one side row is formed by the sequence of side nozzles connected on one end to the outer feed conduit and connected to the mixing chamber on the other end. Instead, both of these references disclose analogous side nozzles connected on one end to the outer conduit where a mixture of both atomization fluid and liquid feed exit the feed injection system into the open area of the riser reactor (for example, element 1 in Fig. 1 of Chen '247). This description is inherent in the claim language as written, but Applicants have amended the claim language to clarify the structure of the present invention as described above.

Furthermore, contrary to the references cited, only the present invention has the following features:

- The positioning of the side nozzles (120) carrying the liquid feed perpendicular to the atomizing fluid (central) nozzles (110) causes the contact between the atomizing fluid and the liquid feed to be very efficient, such that liquid feed is nearly instantaneously accelerated, promoting atomization of same;

- For each central nozzle (110) there are two liquid feed nozzles (120), those being directed so that the central lines of the three nozzles are intercepted at one single point. Hence the transfer of the quantity of movement generated by depressurization of the atomizing fluid to the liquid feed is very efficient, with the consequent promotion of excellent atomization;

- The contact of the liquid feed and atomization fluid through nozzles leads to optimization since the mixing chamber is one single element without any compartments as in the cited references;

- Nozzles for the liquid feed: Chen '247 does not provide nozzles for the liquid feed: see column 4, lines 31-35: "Liquid hydrocarbon feed 8 enters conduit 28, continues through substantially vertical second conduit 38 via annulus 9 to a second cap 48 and is mixed in a cross-flow with the first dispersing gas 12 in mixing zone 42, resulting in the formation of a fine two-phase mixture of small dispersed bubbles...."

- See also Figure 1 in Chen '247, where the mixing zone of the liquid feed and atomization fluid is separated from the contact region of the spray and catalyst by a metal wall having passages for the spray. Such a wall or obstacle is absent from the present application.

Based on the foregoing reasons, Applicants submit that neither Chen '857 nor Chen '247 anticipate each and every element of Applicants' claimed invention.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections under 35 U.S.C. § 102(b and e).

***Response to Claim Rejections - 35 U.S.C. §§ 102/103***

A. Claim 8 is rejected under 35 U.S.C. 102(e) as allegedly anticipated by or, in the alternative, under 35 U.S.C. 103(a) as allegedly obvious over Chen (U.S. Pat. No. 6,387,247).

B. Claims 20-22 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Chen (U.S. Pat. No. 6,387,247) in view of Williatte et al. (U.S. Pat. No. 5,037,616).

The Examiner cites Williatte as disclosing a nozzle for feed injection into an FCC reactor riser and as teaching the use of a venturi in order to achieve atomization of the feed (col. 4, lines 5-39). The Examiner notes that both converging and diverging forms are in a venturi.



C. Claim 26 is rejected under 35 U.S.C. 103(a) as assertedly being unpatentable over Chen (U.S. Pat. No. 6,387,247) in view of Steffens et al. (U.S. Pat. No. 5,173,175).

The Examiner cites Steffens et al. as disclosing a feed nozzle for the riser of an FCC reactor and teaching that "in a typical unit, the feed injector may discharge at an angle to the riser of between 0° and 75°" (col. 5, lines 43-49).

Applicants respond as follows.

As each of these dependent claims incorporates by reference the subject matter of at least independent Claim 1, Applicants rely on the remarks provided above against Chen '247 and submit that dependent Claims 8, 20-22 and 26 are patentable for at least the same reasons.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections under 35 U.S.C. § 102(e)/103 and §103.

### ***Conclusion***

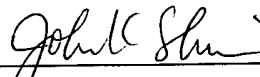
In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

**AMENDMENT UNDER 37 C.F.R. § 1.111**  
U.S. Application No. 09/694,774

**Q61420**

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



John K. Shin  
Registration No. 48,409

SUGHRUE MION, PLLC  
Telephone: (202) 293-7060  
Facsimile: (202) 293-7860

WASHINGTON OFFICE

**23373**

CUSTOMER NUMBER

Date: October 7, 2004



TABLE 1

Feed and conversion features	Test 1 (control)	Test 2 Invention	Difference
Feed (m <sup>3</sup> /d)	9117	9115	-2
D20/4	0.9418	0.9403	
RCR (%w)	1.79	1.26	
RTX (°C)	540	541	+1
CFT(°C)	273	243	-30
DPT (°C)	727	709	-18
C/O	5.57	6.40	
<b>Product Yields(%w)</b>			
Combined Gas	6.77	5.71	- 1.06
LPG	12.55	12.90	+ 0.35
Cracked Naphtha	43.41	46.49	+ 3.08
LCO	15.61	14.38	- 1.23
DO	15.31	14.78	- 0.53
Coke	6.34	5.74	- 0.60
App. Conversion (%v)	70.46	73.24	+ 2.78
Corrected. App. Conversion. (%v)	71.31	73.65	+ 2.34
Neat Conversion (%v)	87.19	88.55	+ 1.36
Naphtha Quality			
MON	80.1	81.0	+ 0.9
RON	94.1	95.5	+ 1.4

Where:

- 5 RCR is the Ramsbottom Carbon Residue  
 RTX is the Reaction Temperature as measured on the top of the riser  
 CFT is Combined Feed Temperature  
 DPT is the regenerator temperature in the dense phase

**I CLAIM:**

1. A feed-dispersion system for fluid catalytic cracking units (FCC) for introducing a liquid hydrocarbon feed atomized by an atomization fluid in a reactor for fluid catalytic cracking, wherein said system comprises:

- a feed injection system made up of two concentric conduits, inner conduit and outer conduit of substantially circular section, where the atomization fluid introduced through flange flows through the inner conduit while the liquid hydrocarbon feed introduced through flange flows through the annular space formed by the outer surface of the inner conduit and the inner surface of the outer conduit ;
- an atomizing unit comprising nozzles arranged in rows, with a central row formed by the sequence of nozzles connected to the inner conduit of atomization fluid, and by at least one side row formed by the sequence of side nozzles connected to the outer feed conduit, where in this unit:
  - the central nozzle(s) and side nozzle (s) of the said atomizing unit are geometrically placed so as to transfer, by contact, the energy of the atomization fluid to the flow of liquid feed;
  - a mixing chamber is formed by the combination of the discharge zones of the central nozzle(s) of atomization fluid.

2. A feed-dispersion system according to claim 1, wherein the liquid hydrocarbon feed is a light gasoil, a heavy gasoil or an atmospheric residue, alone or admixed.

3. A feed-dispersion system according to claim 1, wherein the atomization fluid is an inert gas used between 1 and 5% by weight, preferably 2 and 4% by weight, based on the weight of the feed.

4. A feed-dispersion system according to claim 3, wherein the inert gas is nitrogen.

5. A feed-dispersion system according to claim 3, wherein the inert gas is fuel gas.

6. A feed-dispersion system according to claim 3, wherein the inert gas is steam.

7. A feed-dispersion system according to claim 1, wherein for each central nozzle of atomization fluid there is at least one feed side nozzle.

REQUEST OF EARLY NOTIFICATION OF SERIAL NUMBER

Inventor(s): Edson Jose Joaquim DE SOUZA, Aurelio Medina DUBOIS,  
Claudio Damiance BAPTISTA, Jose Geraldo Furtado RAMOS,  
Jose Loreto Moreira DE FARIA, Moacir Jose BAMPI

Title: FEED-DISPERSION SYSTEM FOR FLUID CATALYTIC  
CRACKING UNITS AND PROCESS FOR FLUID CATALYTIC  
CRACKING

Atty Doc. #: Q61420 Client: Petroleo Brasileiro S.A. PETROBRAS

Filing Date: October 24, 2000 # Pgs. Spec/Abst: 17/1 #Claims: 27

# Dwg. Sheets: 4 Decl NO Prelim Amdt NO

PTO FORM 1449 w/refs.

IDS/Prior Art: YES Pr Doc: YES(1) Asgmt: NO Fee: \$836.00

☐ Check Attached ☐ Charge to Deposit # 19-4880 Atty/Sec: WAB/slb

SERIAL NO.:

